Individual Project 2: Ecosystems Connections

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Part I.

The ocean environment is so interconnected and dynamic in nature, that any human activity taking place near a site can influence the natural processes happening within and among the marine ecosystems.

Among the human activities conducted around the coastal zone with significant impact on marine ecosystems are: gas and oil exploration and exploitation, fisheries, urbanization, tourism, agricultural and industrial discharges, and shipping. Tourism has been increasingly affecting marine as well as terrestrial ecosystems. Increasing numbers of visitors to marine ecosystems put a stress on the stability of the ecosystems biota and water quality. Irresponsible actions are often committed without accountability.

Among the coastal marine ecosystems threatened by these activities are **bioluminescent bays**. These are rare and fragile ecosystems. Bioluminescent microorganisms are found in almost all tropical ocean waters, however, if they are not found in large numbers, you do not see the glow. In the bio bays, large numbers of dinoflagellates, ctenophores, and other bioluminescent organisms are trapped by the currents. *Figure 1* shows the bathymetry of the bay, which is very shallow with a narrow opening to the sea. The deepest spot would be no more than 8 feet. They are an average of 3 to 4 ft. in depth.

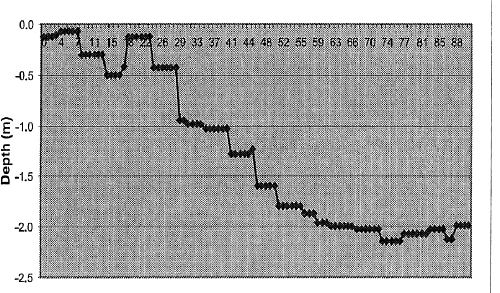


Fig. 1

When the tide comes in, it brings the microorganisms into the bay. They are phototactic, therefore, they stay on the water surface. The climate around these areas is arid. Temperatures are high and rainfall scarce. Therefore, there is significant evaporation on the surface, leaving saltier, denser water which sinks to the bottom and travels out of the bay. The bioluminescent dinoflagellates stay on the surface and do not leave the bay. *Figure 2* shows another important element of a bioluminescent lagoon; the fringe of **mangrove forest** that surrounds it.

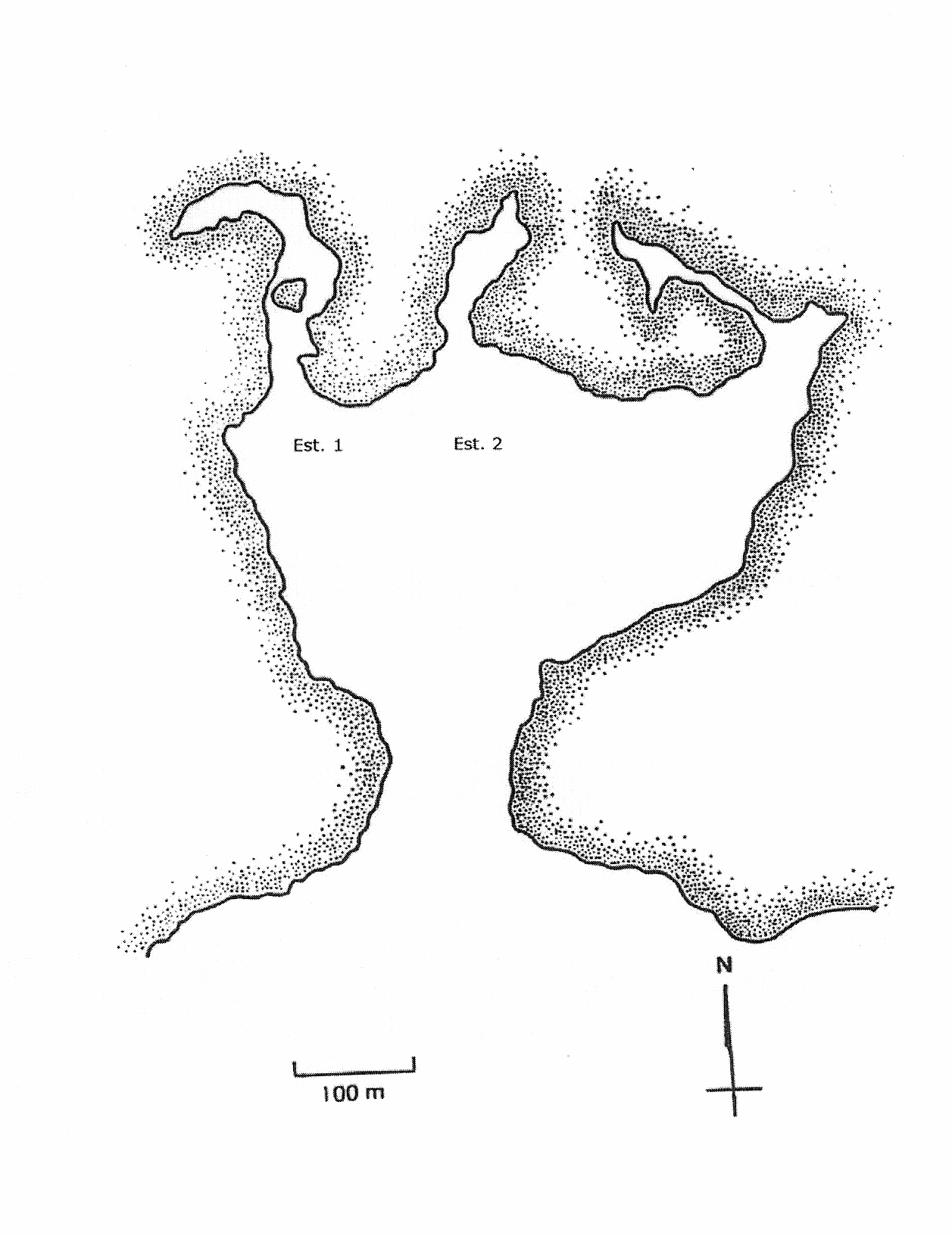


Fig. 2

These two systems coexist beautifully if left undisturbed. The bioluminescent organisms need a chemical substance produced by the organic matter decomposition and microbial activity associated with the sediments near the red mangrove roots. Ostracods, copepods, shrimp, amphipods, and other small invertebrates eat detritus produced by the falling leaves of the mangrove tree. They act as a link to intermediate and terciary carnivores. Fish come to the mangrove root system to lay eggs. It sustains and protects juveniles of numerous edible tropical fish, which migrate to the coral reef when they become adults. There are mussels and oysters that grow on the submerged but floating roots of red mangrove. Many species of birds nest on the canopy of the mangroves and then fish in the waters of the bay. The mangroves are also nesting grounds for at least four types of sea turtles. Fishermen capture crabs, oysters, and fish in the mangrove fringe and in the bay. Many visitors of the mangrove come to it by sea through the bay.

Figures 3, 4, 5, and 6 show some of the fauna of these systems.

Fig. 3 Land Crab



Fig. 4 Barracuda (top) and Little tunny (Bottom)

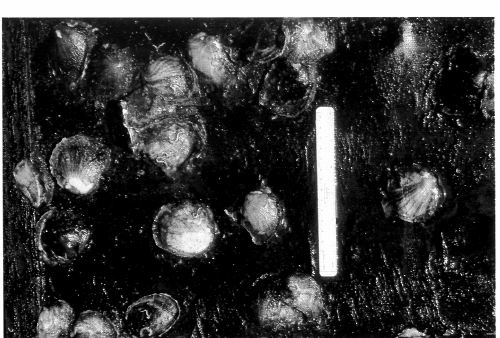
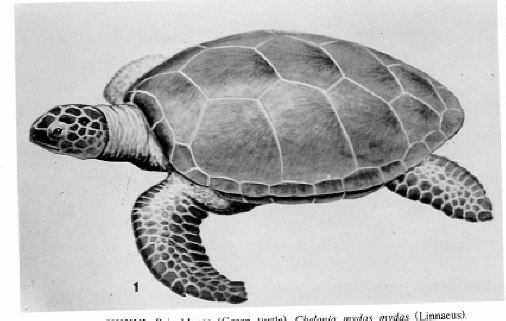


Fig. 5 Mangrove oyster (top) and fig. 6 green turtle (bottom)



El Mar de Puerto Rico

Suarez Caabro

During the last 20 years, there has been an increasing interest in ecotourism. People come from many countries to study or just enjoy the beauty of kayaking in a bioluminescent lagoon. They surely take back with them the enthusiasm and desire to protect and appreciate these natural wonders. However, there are many threats to these water bodies, precisely through unregulated tourism and coastal expansion.

I wish to add that in Puerto Rico, bioluminescent bays have been studied by NOAA and Sea Grant, numerous students from universities around the world; some of which come to study marine sciences in Mayaguez.

**Estuaries** form a transition zone between river ecosystems and ocean ecosystems The ocean brings the tides and the waves, moving sediments and microorganisms into the mouth of the river. It brings salt water that will change the salinity, mineral composition ( chemistry), and density of the river water. The river brings a flow of fresh water which lowers the salinity, density, and specific gravity of the water. It brings a huge amount of sediment with an abundance of dissolved solids and minerals as well as organic matter from domestic wastes and industrial and agricultural runoff. The circulation of both seawater and freshwater make the level of nutrients very high, both in the water column and sediments. Thus, estuaries are among the most productive natural habitats of the marine environment.

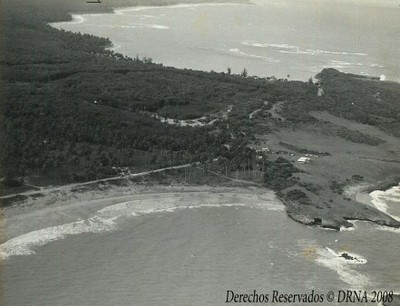


Figure 7 Vacia Talega in Puerto Rico

Photo from DNRPR.

Due to the variability of salinity and sedimentation, most fish have methods to adapt to the changes in salt concentrations. Invertebrates also have some type of osmoregulators. Many animals choose to burrow into the sediments to protect themselves from predators and to be in a more stable environment.

In the sediments of estuaries there are large numbers of bacteria which have a very high oxygen demand. This reduces the levels of oxygen available for other populations.

Filter feeders especially benefit from the suspended particles in the water columm. I have seen many locals fishing for oysters which they in turn sell in the street. Many of the characteristics previously mentioned about the mangrove and the bioluminescent bays also apply to estuaries.

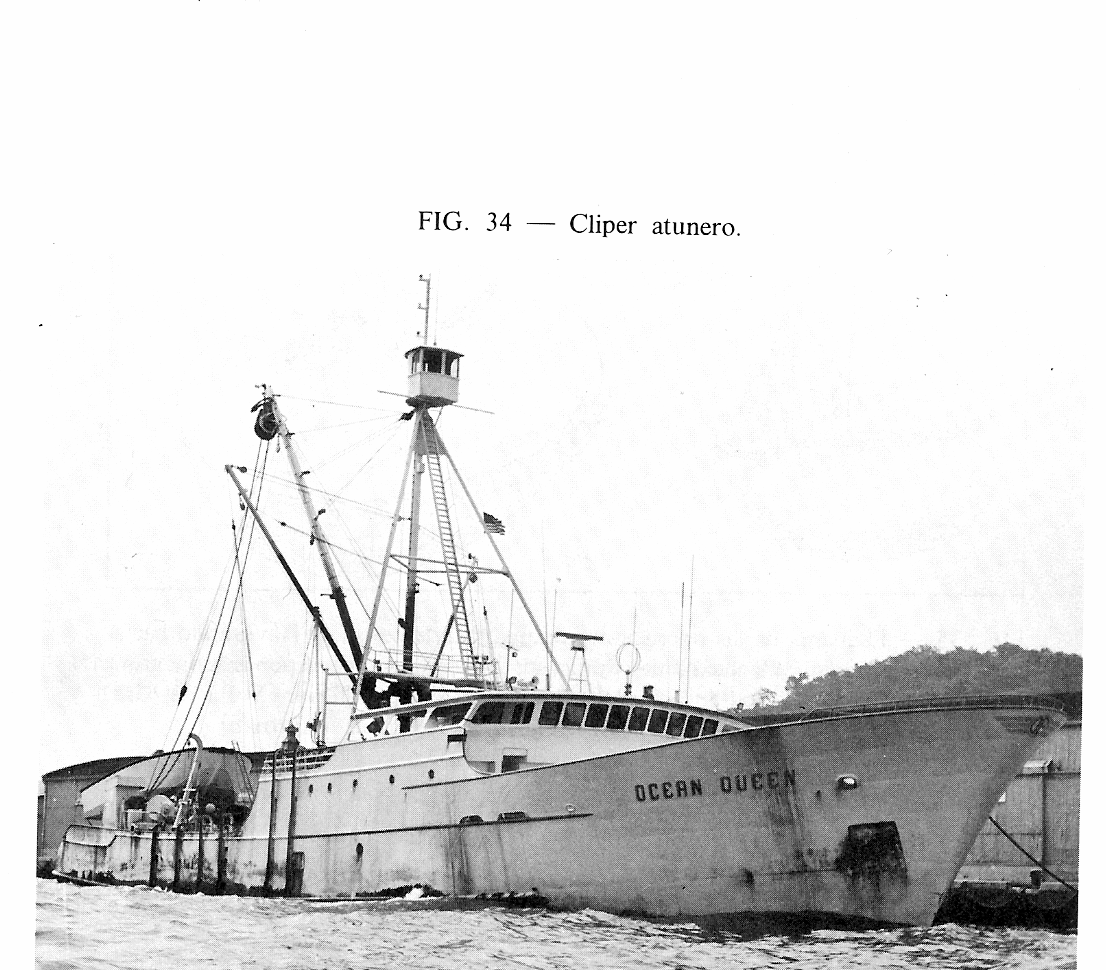


Figure 8 From El Mar de Puerto Rico

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Tuna clipper

**Fishing** is the third connection between a marine ecosystem and a terrestrial one. There is fishing for recreation, fishing as a craft for survival, and there is the fishing industry, such as cod and tuna. Fishing could also be divided into categories depending on their catch: shrimp, sponges, fish, lobsters, etc.

In any of these, **human activity** is a major component. Humans create diverse tools, from simple nets thrown from shore to high tech nets drawn by big ships. There is trawling and scallop dredging that interact more with the organisms on the seafloor. The major interaction within these two ecosystems is the need that humans have for a productive ocean. The amount of fish and other catch is dependent upon the fishermen’s respect for their full development. For example, it is critical that lobsters are caught after they reproduce. Otherwise, the amounts of lobsters will be dramatically reduced. This industry affects the balance of the marine species depending on how much or how frequently they are fishing them. There are many species of marine organisms on the threatened or endangered lists.

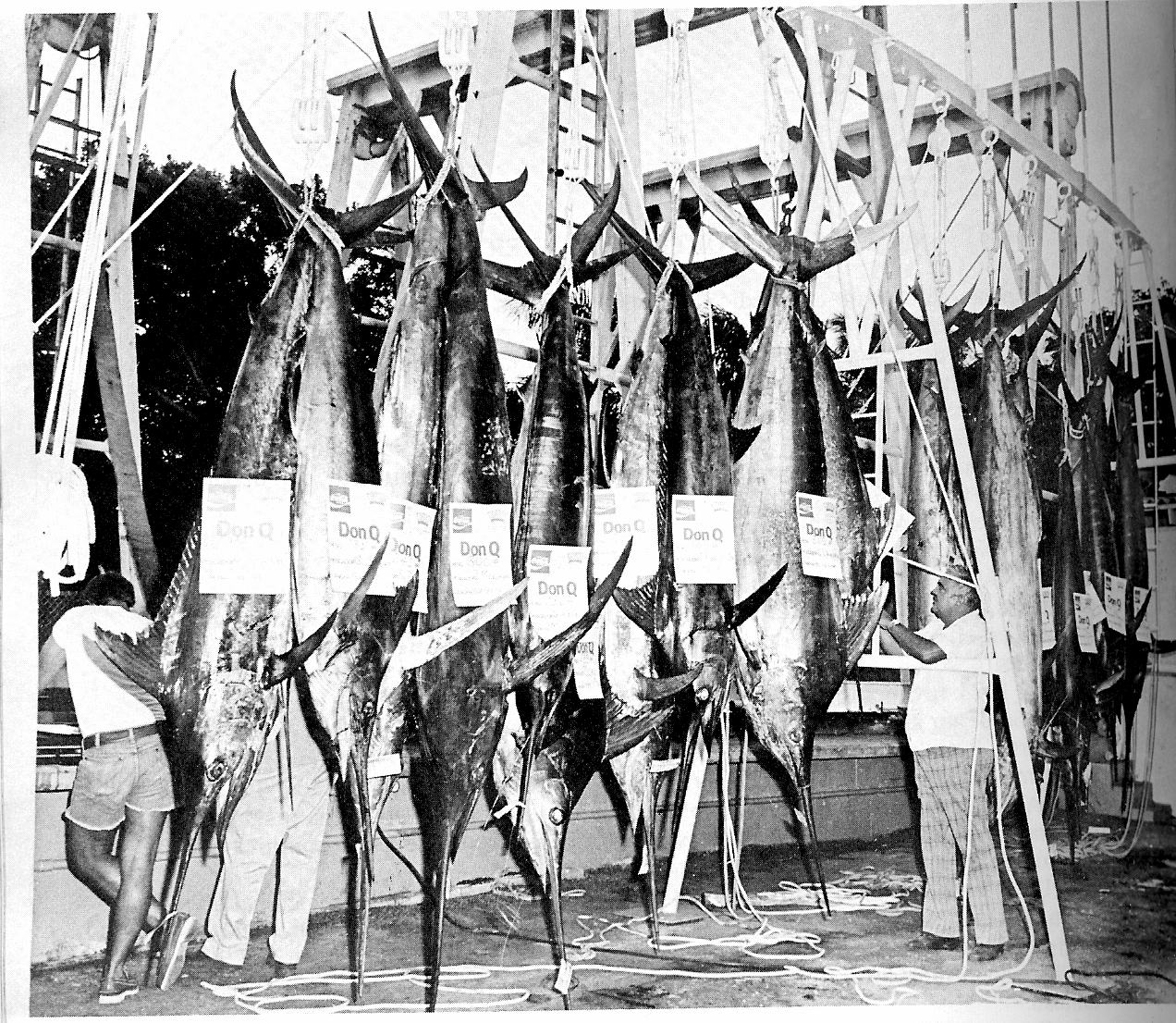


Figure 9 El Mar de Puerto Rico

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Sport fishing is very popular. Blue Marlin Tournaments demand a lot of catch from the coastal waters.

The result of all this demand on the ocean is that either the ocean is able to repopulate on time or there will be a scarcity of fish.

**UNESCO’s** website has numerous studies’ documents from all over the world that describe legislation

and findings of the conditions of marine environments. NOAA has an enormous amount of information.

Part of the information on the bioluminescent bays was read on The Hydrodynamics and Biogeochemistry of Bioluminescent Bays, Vieques, PuertoRico a study by Suzanne O’Connell, Tim C. Ku, and Anna Martini.

Part II.

The largest percent of marine pollution is originated from land-based sources. Run-off and point source pollution from urban, agricultural, and industrial activities puts significant pressure on the marine environment. However,

policies that regulate fishing need to be more consistent around the globe. Gas and oil exploitation regulations perhaps need to be revised.

**The fishing industry** itself, needs to be better regulated in regional and international waters. Large capacity and excess effort in some fisheries, has resulted in overfishing and decreased availability of marine species populations.

The northern hemisphere specifically, is associated with collapsing fisheries that carry a great economical damage.

Countries like Australia are trying to be more conservative and careful in managing the use of their coatal waters for such purposes.

Numerous seabird populations around the globe are affected by the impact of overfishing. Even though some countries struggle to protect their marine environment, they are experiencing a decline in species such as bluefin tuna, southern sharks, orange roughy, and other commercial varieties.

Some of the fishing ships transport exotic species from one place to another in their ballast water, thus creating a problem for endemic species of fish and other marine organisms.

The fishing ships sometimes use TBT which is a chemical that prevents marine organisms from attaching to the hulls of the boats. This is a highly toxic substance that will also affect marine life.

The oil spills that have happened have injured marine ecosystems for years. As I said, human activity is usually a heavier hand on the ecological balance of the ocean.

In general, the pollution is coming from many directions at the same time. Contaminants such as plastics, pesticides, phenols, and heavy metals, are increasingly polluting the ocean. These will not disintegrate in many years.

According to UNESCO, the world is in a spiral of marine resource degradation. Countries will need to come together to improve their coordination, to safeguard marine biological diversity.

There are immediate plans to invest millions of dollars in funding programs for the control of marine pollution.

Regional governments, for example, in some Asian countries, will have to recognize the need to implement ecosystem-based planning.

There will be increased programs for fish habitat rehabilitation and marine species protection. Massive educational campaigns need to be put into place, so that governmental efforts are not wasted without societal support.

As a result of human impact on the ocean capacity to feed us, the availability of product (or seafood) will be in constant reduction. This will have continuous economical impact on society. Jobs, prices, stock market values, and even transportation of the supply, will be too fragile or variable creating unstable conditions globally.